teóricas, que existe um real problema de teoria e prática no que diz respeito aos modelos ambientais (enfoque aos que se ocupam do uso do solo) que se configura como um problema de ordem política.

B4m: FOREST TREE AND STAND GROWTH PROCESSES UNDER DIFFERING ENVIRONMENTS: CONCEPTS, METHODS AND EVIDENCE - 2

Spatial fine root distribution in pure and mixed stands of European beech, Norway spruce, and Douglas-fir under different site conditions

Amani Saul Lwila[1], Christian Ammer[1], Martina Mund[1]
[1]Burckhardt-Institut - Georg-August-Universität Göttingen, Göttingen, Germany (amani.lwila@uni-goettingen.de; christian.ammer@forst.uni-goettingen.de; martina.mund@forst.uni-goettingen.de)

Inter and intraspecific competition play an important role on below ground functional traits and resulting ecosystem functioning. Root biomass production is not the only determinant for below ground success but also rapid vertical and horizontal roots capability to explore the additional soil space along the limited resources. We investigated the impact of inter-intraspecific competition on spatial fine root distribution, and how the effects differ with site conditions and species identity. By pulling together the effect of site condition and different in competitions effects on ecosystem functioning, helped us to understand the existing complementarity between the species in water usage as strategies to reduce drought water stress. We studied the spatial fine root distribution in four quintets comprising in total 20 mature stands aged over 60 years of pure beech, pure spruce, pure Douglas-fir, mixed beech-spruce, and mixed beech-Douglas fir in Northwestern Germany. We considered the site quality by analyzing site nutrient and intra-and interannual variation in weather conditions, and soil moisture our findings show that, beech and douglas-fir have high plasticity by changing with site conditions and competition while spruce shows to be more conservative in changing, e.g. the mixed stands of Douglas-fir and beech shows higher interspecific root diversity, specific root lengths and biomass of fine root than pure stands and mixed stands of spruce and beech, this difference was more pronounced with changes in site quality. Our finding will help to understand the below ground complex interaction in responses to species identity, site quality and inter and intraspecific competition.

Multi-layered scots pine forests in boreal Sweden result from mass regeneration and size stratification

Lars Lundqvist[1], Martin Ahlström[1], Petter Axelsson[2], Tommy Mörling[1], Erik Valinger[1]
[1]Dept of forest ecology and management, SLU, Umeå, Sweden; [2]Dept of wildlife, fish and environmental studies, SLU, Umeå, Sweden (lars.lundqvist@slu.se; martin.a.ahlstrom@slu.se; petter.axelsson@slu.se; tommy.morling@slu.se; erik.valinger@slu.se)

Understanding historic development of multi-layered Scots pine (*Pinus sylvestris* L.) stands and how they became multi-layered is essential for assessing the feasibility of other management practices than rotation-forestry and clear cutting. To address this we measured trees (DBH $\geq$ 4 cm) and saplings (height > 0.5 m DBH < 4 cm) and used increment cores from 244 sample trees to reconstruct stand structure development, ingrowth and basal area increment in four multi-layered Scots pine stands in Sweden. Three of the four stands had age distributions that were dominated by one or two 20 year age classes, suggesting that the irregular diameter distributions displayed in 2013 had developed from more homogeneous distributions. Analyses of the historical ingrowth of Scots pine into the tree layer suggested that the multi-layered structure was created by mass regeneration followed by size stratification caused by differences in growth rates within even-aged cohorts of regeneration. Large basal area reductions in the past resulted in abundant regeneration and ingrowth of Scots pine. When the overstory increased in basal area over time, there was a growth differentiation among the saplings and small trees, gradually creating a multi-layered stand structure as some of the trees grew into the larger size classes while others remained in the smaller size classes. When the stands reached a basal area of 13-14 m^2ha^{-1} the ingrowth of saplings past 1.3 m height essentially stopped but the size stratification among the small trees continued, further enhancing the multi-layered structure.

Estimating aboveground net biomass change in tropical and subtropical forests: refinement of IPCC default values using forest plot data

Daniela Requena Suarez[1], Danaë M. A. Rozendaal[1,2,3], Veronique De Sy[1], Oliver L. Phillips[4], Esteban Alvarez-Dávila[5,6], Kristina Anderson-Teixeira[7,8]; Alejandro Araujo-Murakami[9], Luzmila Arroyo[10], Timothy R. Baker[4], Frans Bongers[11], Roel J. W. Brienen[4]; Sarah Carter[1], Susan Cook-Patton[12], Ted R. Feldpausch[13], Bronson W. Griscom[12], Nancy Harris[14], Bruno Hérault[15], Euridice N. Honorio Coronado[16], Sara M. Leavitt[12], Simon L. Lewis[4,17], Beatriz S. Marimom[18], Abel Monteagudo Mendoza[19,20], Justin Kassi N'dja[21], Amy Estelle N'Guessan[21], Lourens Poorter[11] Lan Qie[22], Ervan Rutishauser[23], Plinio Sist[15], Bonaventure Sonké[24], Martin J. P. Sullivan[4], Emilio Vilanova[25,26], Maria M. H. Wang[27], Christopher Martius[28], Martin Herold[1]
[1]Laboratory of Geo-Information Science and Remote Sensing, Wageningen University and Research, Wageningen, Netherlands; [2]Plant Production Systems Group, Wageningen University and Research Wageningen Netherlands; [3]Centre for Crop Systems Analysis, Wageningen University and Research, Wageningen, Netherlands; [4]School of Geography, University of Leeds, Leeds, United Kingdom; [5]Escuela de Ciencias agrícolas, pecuarias y ambientales, Universidad Nacional Abierta y a Distancia, Bogotá, Colombia; [6]Fundación ConVida, Medellín, Colombia; [7]Conservation Ecology Center, Smithsonian Conservation Biology Institute, Virginia, USA; [8]Center for Tropical Forest Science-Forest Global Earth Observatory, Smithsonian Tropical Research Institute, Panama, Panama; [9]Museo de Historia Natural Noel Kempff Mercado, Universidad Autónoma Gabriel René Moreno, Santa Cruz, , Plurinational State of Bolivia; [10]Universidad Autónoma Gabriel René Moreno, Santa Cruz, Plurinational State of Bolivia; [11]Forest Ecology and Forest Management, Wageningen University and Research, Wageningen, Netherlands; [12]The Nature Conservancy, Arlington, USA; [13]Geography, College of Life and Environmental Sciences, University of Exeter, Exeter, United Kingdom; [14]World Resources Institute, Washington DC, USA; [15]Cirad, UR Forests & Societies, University of Montpellier, Montpellier, France; [16]Instituto de Investigaciones de la Amazonia Peruana, Iquitos, Peru; [17]Department of Geography, University College London, London, United Kingdom; [18]Universidade do Estado de Mato Grosso, Campus de Nova Xavantina, Nova Xavantina, Brasil; [19]Jardín Botánico de Missouri, Oxapampa, Peru; [20]Universidad Nacional de San Antonio Abad del Cusco, Cusco, Peru; [21]Université Félix Houphouet-Boigny, UFR Biosciences, Laboratoire de Botanique, Abidjan, Côte d'Ivoire; [22]School of Life Sciences, University of Lincoln, Lincoln, United Kingdom; [23]Smithsonian Tropical Research Institute, Panama, Panama; [24]Plant Systematic and Ecology Laboratory, University of Yaoundé, Yaoundé, Cameroon; [25]Universidad de Los Andes, Mérida, Venezuela, Republic of Bolivarian; [26]School of Environmental and Forest Sciences, University of Washington, Seattle, USA; [27]Department of Animal & Plant Sciences, University of Sheffield, Sheffield, United Kingdom; [28]Center for International Forestry Research (CIFOR), Bogor, Indonesia (daniela.requenasuarez@wur.nl; danae.rozendaal@wur.nl; veronique.desy@wur.nl; o.phillips@leeds.ac.uk; esalvarez3000@gmail.com;

esalvarez3000@gmail.com; teixeirak@si.edu; araujomurakami@hotmail.com; luzmilaarroyo@hotmail.com; t.r.baker@leeds.ac.uk; frans.bongers@wur.nl; r.brienen@leeds.ac.uk; sarah.carter@wur.nl; susan.cook-patton@tnc.org; t.r.feldpausch@exeter.ac.uk; bgriscom@tnc.org; nharris@wri.org; bruno.herault@cirad.fr; eurihc@yahoo.com; sara.leavitt@tnc.org; s.l.lewis@leeds.ac.uk; biamarimon@unemat.br; amonteagudomendoza@gmail.com; kassindja@yahoo.fr; annyestellen@yahoo.fr; lourens.poorter@wur.nl; lqie@lincoln.ac.uk; er.rutishauser@gmail.com; [1]plinio.sist@cirad.fr; bonaventuresonke@ens.cm; m.j.sullivan@leeds.ac.uk; vilanova@uw.edu; mariawang1990@gmail.com; c.martius@cgiar.org; martin.herold@wur.nl)

As countries advance in greenhouse gas (GHG) accounting for climate change mitigation, consistent estimates of aboveground biomass (AGB) net change are needed for the tropics and subtropics. Countries with limited forest monitoring capabilities rely on 2006 IPCC default AGB net change values, which are averages per ecological zone, per continent. These previous defaults come from single studies, provide no uncertainty indications, and aggregate old secondary forests and old-growth forests. In this study, we update these default values using forest plot data. In comparison with previous estimates, new values include data published from 2006 onwards, are derived from multiple sites per global ecological zone, provide measures of variation, and divide forests >20 years old into older secondary forests and old-growth forests. We compiled 176 AGB chronosequences in secondary forests and AGB net change rates from 536 permanent plots in old-growth and managed or logged forests. In this dataset, across all continents and ecozones, AGB net change rates in younger secondary forests (≤20 years) are higher than rates in older secondary (>20 years and ≤100 years) forests and managed or logged forests, which in turn are higher than rates in old-growth forests (>100 years). Data availability is highest for North and South America, followed by Asia then Africa. We provide a rigorous and traceable refinement of the IPCC 2006 AGB net change default rates, identify which areas in the tropics and subtropics require more research on AGB change, and reflect on possibilities for improvement as more data becomes available.

The significance of temporal and spatial variation in forest growth for climate change impact modelling

Hans-Peter Kahle[1], Chaofang Yue[2]
[1]Chair of Forest Growth, Institute of Forest Sciences, Albert-Ludwigs-University Freiburg, Freiburg, Germany; [2]Forest Research Station Baden-Württemberg, Freiburg, Germany (hans-peter.kahle@iww.uni-freiburg.de; chaofang.yue@forst.bwl.de)

The factors that control forest growth vary across spatial and temporal scales. Modificative adaptation allows trees to cope with short-term fluctuations and long-term trends in environmental conditions that occur during their lifetime, as well as enables species growing on diverse sites to adjust to spatial environmental heterogeneity. Whereas it is difficult to determine to which extent such changes in growth response are genetically determined or the result of phenotypic plasticity, it is evident, that individuals with a greater adaptive plasticity will be more likely to survive under environmental change. Models predicting climate change impacts on forest growth often draw upon the space-for-time substitution (SFTS) approach, thus relying on the assumption that the growth response across spatial environmental gradients is analogue to the dynamic growth response over time. Forest inventory-based models typically rely on the SFTS approach. In contrast, longitudinal studies combining time series of forest growth with forest growth variation across space are scarce. In this presentation, we revisit application of the SFTS approach to predict forest production under climate change in light of longitudinal growth data. Based on measurement data from long-term forest research plots we found that site index changes of Norway spruce across spatial climatic gradients largely differ from dynamic changes in site index under climate change. Thus, application of SFTS would produce largely misleading results. Finally, an updated concept is provided to assess the potentials and limitations of the SFTS approach in a systematic way.

Do increasing respiratory costs explain the decline with age in forest growth rate?

P.W. West[1]
[1]Forest Research Centre, Southern Cross University, Lismore, NSW 2480, Australia (pwest@nor.com.au)

Once forests have achieved a full canopy, their growth rate declines progressively with age. This work analysed a global data set with estimates from a wide range of forest types, aged 20-795 yr, of their annual photosynthetic production (gross primary production, GPP) and subsequent biomass production (net primary production, NPP). Both GPP and NPP increased with increasing mean annual temperature and precipitation. GPP was then unaffected by forest age whilst NPP declined progressively with age, meaning that autotrophic respiration increased with age. It has been proposed that GPP should decline in response to increasing water stress in leaves as water is raised to greater heights as trees grow taller with age. However, trees may make substantial plastic adjustment in morphology and anatomy of newly developing leaves, xylem and fine roots to compensate for this stress and maintain GPP with age. This work suggests NPP declines with age as respiratory costs increase progressively in, any or all of, the construction and maintenance of more complex tissues, the maintenance of increasing amounts of live tissue within the sapwood of stems and coarse roots, the conversion of sapwood to heartwood, the increasing distance of phloem transport, increased turnover rates of fine roots, maintaining alive competitively unsuccessful small trees or supporting very tall trees that are unable to compensate fully for increased water stress in their canopies.

B4p: MONITORING FOREST DYNAMICS AND BIOMASS

Forest and biomass dynamics in the Andean forests of Southern Ecuador / *Dinâmica florestal e biomassa nas florestas andinas do Sul do Equador*

Celso Yaguana[1], Deicy Lozano[1], Ney Quezada[2], Jhoana Muñoz[2], Giselda Durigan[3]
[1]Universidade Estadual Paulista "Júlio de Mesquita Filho", Botucatu, Brasil; [2]Universidad Nacional de Loja, Loja, Ecuador; [3]Instituto Florestal do Estado de São Paulo, Assis, Brasil (anibalya09@gmail.com; caroladeicylo@hotmail.com; quezadaney@gmail.com; joana.munoz@unl.edu.ec; giselda.durigan@gmail.com)

As florestas montanhosas andinas são consideradas prioridade global de conservação, especialmente pela elevada biodiversidade e grau de endemismo. No entanto, são ecossistemas fortemente ameaçados por perturbações antrópicas, mas ainda pouco estudados e mal compreendidos. O objetivo deste estudo foi caracterizar a dinâmica da floresta em parcela permanente com área de 1 hectare, na Reserva Natural Tapichalaca, localizada na cordilheira do sudeste dos Andes equatorianos, para quantificar seu papel no armazenamento e, possivelmente, como sumidouro de carbono. Realizamos a amostragem da comunidade arbórea com diâmetro mínimo de 10 cm, em duas ocasiões (2008 e 2018), utilizando o método padronizado pela Rede Amazônica de Inventários Florestais - RAINFOR. A biomassa foi estimada pela equação alométrica para florestas úmidas tropicais de Chave et al. (2005). A biomassa aérea registrada em 2018 foi de 255,63 Mg ha^{-1}, correspondendo a um estoque de carbono aproximado de 128 Mg ha^{-1}. A taxa anual de mortalidade (1,99%) foi similar à taxa anual de recrutamento (1,57%). O incremento diamétrico médio anual foi de 1,94 mm, valores similares aos observados na Amazônia brasileira (1,4–2 mm por ano). A dinâmica da biomassa correspondeu a um incremento de 26,62 Mg ha^{-1} em dez anos, com aumento de 2,82 m2 ha^{-1} na área basal. A floresta estudada, portanto,